Unit 3

Field Preparation and Transplanting in Solanaceous Crops

Introduction

Soil is the most important and easily available growing medium for plants. Soils are of different types, depending upon their chemical and physical properties. Soil provides nutrients and moisture to plants, which are necessary for their growth and development. Manures and fertilisers are added to the soil to maintain its nutrient value. This ensures the availability of nutrients to plants and maintains productivity, as well as, fertility of the soil. Judicious use of fertiliser is always recommended to avoid crop and soil hazards. This may be achieved through testing of the soil and expert opinion. When a soil is pulverised, levelled and brought to fine tilth for the cultivation of a crop, it is called 'tillage operation' or 'preparation of the land'. Different advanced implements are used to prepare the land for cultivation. The need for water may be fulfilled by irrigation.

Most of the solanaceous vegetables are propagated by seed and seedlings are transplanted at requisite spacing in the main field. Seedlings are herbaceous and require care during uprooting and planting.

Session 1: Soil and Field Preparation

Definition of soil

Soil is derived from the Latin word *Solum*. It may be defined as a natural body developed as a result of weathering of rocks, in which plants and other forms of life grow and prosper. It is the upper loose layer of the earth crust rich in nutrients and minerals on which plants grow. Soil is composed of minerals (45–50%), organic matters (0.5–5%), water (25%) and a large number of plants, animals and microbes.

Importance of soil

Soil provides nutrients to plants, which help in their growth. It provides support to growing plants by holding their roots. It holds moisture and water for a long time and serves as a habitat for many micro and macro-organisms. Soil also provides heat, air and water to growing organisms living in or over it. It is the most important natural resource of a country.

Types of soil

There are different types of soil in India, which can be classified on the basis of their colour and characteristics.

Fig. 3.1: Black soil

Black soil

These soils are poor in nitrogen, phosphate and organic matter but rich in potash, calcium and magnesium (Fig. 3.1). The pH of black soil is 6.8.

Fig. 3.2: Red soil

Red soil

These are porous, friable and neutral to acidic in nature. These soils are poor in nitrogen, phosphate, lime and humus (Fig. 3.2). Generally, the pH of red soil is more than 5.

Lateritic (laterite)

These show acidic character with pH of 5 to 6. These soils are porous and have low water holding

capacity. Lateritic soils are deficient in nitrogen, phosphorus, potash, magnesium and lime. Such soils are, generally, found in the states of Karnataka, Kerala and Tamil Nadu.

Alluvial soil

These are productive soils, which are formed due to the deposition of silt by the Ganga and Brahmaputra rivers in course of their heavy flow during the rainy season. Due to meandering of the river course, a rich deposit of alluvial soil develops. The pH of alluvial soil ranges from 6.5 to 8.4.

Desert soil

Desert soils are sandy and found in low rainfall areas. These are alkaline soils with high pH value and are unproductive (Fig. 3.3). The pH of desert soil ranges from 7.6 to 8.4.

Fig. 3.3: Desert soil

Forest and hilly soil

These are the soils of higher and lower elevation found on hills. These are stony and infertile. The pH of such soil is 4.

Peat and marshy land

These soils are highly acidic in nature and black in colour. Excessive wetness of the soil, causing decay and degradation of dead vegetation, forms a layer of partially decomposed organic matter.

Soil particles

Soil particles namely sand, silt and clay are classified according to their size. Clay particles are the finest and are smaller than 0.002 mm in diameter. Loam particles are 0.002–0.02 mm in diameter. Silt particles have 0.02–2.0 mm diameter. Particles larger than 2 mm are sand, gravel or stones. Most soils contain a mixture of sand, silt and clay in different proportions (Table 3.1).

Table 3.1: Proportion of sand, silt and clay in various soils

Soil type	Sand (%)	Silt (%)	Clay (%)
Sandy loam	50–80	0–50	0–20
Loam	30–50	30–50	0–20
Clay loam	20–50	20–50	20–30
Silty clay loam	0–30	50–80	20–30

Soil testing

It is one of the methods to determine the fertility status of a soil, so that recommendations with respect to lacking nutrient or appropriate soil reclamation can be done. A complete soil test programme essentially consists of three basic steps, which are as follows:

(a) soil sampling
(b) soil testing
(c) soil test interpretation and fertiliser recommendations

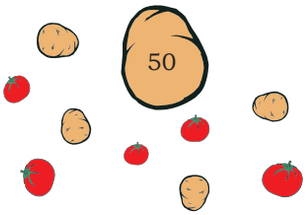
Why is soil testing required?

Soil testing is done to fulfill the following purposes:

(a) help in the evaluation and improvement of soil productivity
(b) determine the nature of soil, i.e., alkaline, saline, acidic, etc., and suggest corrective measures (Table 3.2 and 3.3)
(c) help in deciding the right kind and quantity of fertilisers to be used
(d) reveal the condition of a soil so that it can be improved with proper application of nutrients and other management practices

Soil sampling

Samples are taken using soil auger, soil tube, spade, etc. Different locations in a field are randomly identified. Soil from pits at plough depth (15–20 cm) is collected from identified locations, and then, composited. Samples should not be taken from the boundary of a field. Shady, marshy, near irrigation source and fertiliser applied areas are also avoided. The soil is



mixed thoroughly and spread on a clean sheet of paper or on a piece of cloth. It is divided into four equal parts by drawing a cross sign with the help of a wooden stick. Two opposite quarters are rejected and samples from the other two are mixed. The procedure is repeated till the desired size of the sample is obtained (1/2 kg), which is collected in a paper bag and later packed in a plastic bag.

This bag containing the sample is labeled and sent to the nearest soil testing laboratory of the Department of Agriculture, ICAR institutes, KVKs and SAUs, along with an information sheet.

Information sheet required for soil testing

- Name of the farmer
- Identification or the number of the field
- Date of sampling
- Depth of sampling
- Address of the farmer
- Type of land unirrigated, irrigated, waterlogged
- Source of irrigation (canal, well, tank, etc.)
- Topography (level, sloppy, undulated)
- Crop rotation followed
- Previous crop
- Next crop to be cultivated
- Details of manures or soil amendments applied earlier
- Any other remark
- Signature or thumb impression of the farmer

Soil test result

Based on the soil analysis, the soils are classified into categories according to the ratings as given in the following tables.

Table 3.2: Soil types on the basis of soil pH

S. No.	Type of soil	Soil reaction (pH)
1.	Acidic	below 7.0
2.	Neutral	7.0
3	Neutral to saline	7.0–8.5
4.	Tending to become alkaline	8.6–9.0
5.	Alkaline	above 9.0

Table 3.3: Soil types on the basis of soil Electro-conductivity (EC)

S. No.	Category	EC (milli-mhos/cm)
1.	Normal	below 1.0
2.	Critical for germination	1.0–2.0
3.	Critical for the growth of salt sensitive crops	2.0–3.0
4.	Injurious to most crops	above 3.0

On the basis of soil test interpretations, the recommendations for fertiliser and soil reclamation material for each crop can be made (Table 3.4).

Table 3.4: Rating of soil on the basis of nutrient availability

S.No.	Nutrient	Low	Medium	High
1.	Organic carbon	below 0.5%	0.5–0.75%	above 0.75%
2.	Available nitrogen (N)	below 280 kg/ha	280–560 kg/ha	above 560 kg/ha
3.	Available phosphorus (P)	below 10 kg/ha	10–25 kg/ha	above 25 kg/ha
4.	Available potassium (K)	below 110 kg/ha	110–280 kg/ha	above 280 kg/ha

Soil Health Card Scheme

The scheme was launched by the Government of India in February 2015. Under this scheme, a Soil Health Card is issued to farmers. It contains information about the different nutrients present in a crop and fertilisers recommended for a farm. It helps farmers to improve their crop's productivity through judicious use of fertilisers and other resources. The soil crop's samples are collected on grid basis and tested in soil testing labs. The experts analyse the soil crop and suggest suitable measures for optimum crop production. The results and suggestions are displayed in the cards for farmers to understand the nature of the soil and its suitability to cultivate a particular crop.

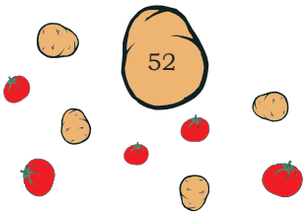
Field preparation for solanaceous crops

Selection of field

Solanaceous crops are grown in different kinds of soil — ranging from sandy loam to clayey loam. For the successful cultivation of solanaceous crops, the soil must be fertile with continuous supply of nutrients and proper drainage facility. Light soils are preferred for early crop and loam or clayey soils for a higher yield. The optimum soil pH for tomato is 6–7. It can tolerate a little soil acidity up to 5.5. Brinjal can tolerate slightly acidic soil, pH ranging from 5.5 to 6.8. For chilli cultivation, the soil pH must be 6.5–7.5. Chillies are grown on heavy black cotton soil during the rainy season, particularly dry chilli.

Land preparation

The soil is dug out to a certain depth, resulting in big clods (ploughing), which are further broken down to



make the soil fine and smooth with the required tilth. This facilitates weed management, ploughing back of crop residues, water infiltration, soil aeration, and root penetration and development. Land preparation includes ploughing, crushing of clods, levelling, harrowing, etc.

Procedure for land preparation

A field should be ploughed up to a depth of 30 cm or more (Fig. 3.4). After this, discing or harrowing in two directions should be done using disc harrows (Fig. 3.5). If a field has to be furrow irrigated, make raised beds of 15–20 cm height using bed lifters. The bed height is determined by the type of the soil, irrigation method and intended crop. Raised beds must ensure the drainage of excessive water, rapid drying of soil surface and early soil warming, less chances of soil-borne diseases, and improved soil aeration. Manure and other compost in the soil must be applied at the time of land preparation. Heavy soils often break in clods and lumps. Heavy clods and lumps can be crushed with the use of a heavy roller. Irrigation before planting is needed if the soil has insufficient moisture after bed preparation. Once the soil dries, the rough beds should be reworked using a rolling cultivator or a power rotavator.

Fig. 3.4: Ploughing of a field

Fig. 3.5: Land preparation using disc harrows

Rotavator mellowing improves the soil structure by breaking up the clods and ploughing out the weeds that emerge after pre-plant irrigation. The final seed bed preparation can be done with the help of a bed roller, planker or laser leveler. It may be done manually by using a spade, hand hoe, etc.

Land and field preparation can be done by:

- deep working implements, like ploughs;
- surface working implements, like rotavator, harrows, hand hoes, *khurpi*, etc.; and
- compacting implements, like rollers, levelers, beams, etc.

What have you learned?

Now, I am able to:

- describe the soil and its types.
- understand soil testing and fertiliser or nutrient recommendation.
- demonstrate field preparation.
- understand the importance of Soil Health Card Scheme.

Practical Exercises

Activity 1: Preparation of a soil sample and with an information sheet

Material required: Soil auger, soil tube, spade, paper bag, plastic bag, weighing scale and wooden stick

Procedure

- Identify a location in a field from where a sample has to be collected.
- Dig pits of 15–20 cm and remove the dug out soil.
- Collect a sample for testing from below this depth.
- Similarly, identify other locations in the field and collect samples.
- Mix the samples thoroughly and spread it on a clean sheet of paper or a piece of cloth.
- Divide it into four equal parts by making a cross sign with the help of a stick.
- Mix the two opposite parts and discard the remaining two.
- Repeat the procedure till you have 500 g sample.
- Put it in a paper bag with a label inside.
- Put the paper bag in a polythene bag.
- Label it and send to a soil testing laboratory.

Precautions

- The sample must not be collected from the boundary of a field, shady and fertiliser applied areas.
- It must not be taken from a place near an irrigation source.
- The collected sample needs to be dried to get uniform mixing.

Check Your Progress

Fill in the Blanks

1. The word 'soil' is derived from a Latin word _____.
2. Soil develops as a result of _____ processes.
3. The pH of black soil is _____.
4. Laterite soils are mostly found in _____.
5. Soil sample is collected at a depth of _____.

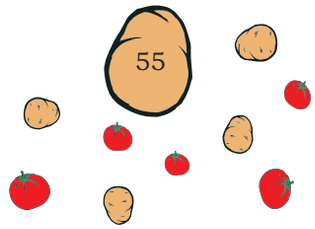
Multiple Choice Questions

1. Black soil is _____.
   (a) poor in nitrogen
   (b) rich in organic matter
   (c) rich in phosphate
   (d) poor in potash
2. Red soil has which of the following character?
   (a) water stagnant (b) marshy
   (c) porous (d) infertile
3. Lateritic (laterite) soil is _____ in nature.
   (a) alkaline (b) acidic
   (c) neutral (d) saline
4. Which of the following is a characteristic of alluvial soil?
   (a) poor quality soil (b) non-productive
   (c) infertile (d) productive
5. Desert soil is found in _____.
   (a) low rainfall areas
   (b) average rainfall areas
   (c) high rainfall areas
   (d) all of the above

Descriptive Questions

1. What is soil? Briefly describe the properties of soil.
   _____
   _____
   _____
2. What is the importance of soil in relation to plant growth?
   _____
   _____
   _____
3. Classify the soils of India.
   _____
   _____
   _____
4. What do you understand by soil testing? Why is soil testing required and how is it done?
   _____
   _____
   _____
5. How is field preparation done for solanaceous crops?
   _____
   _____
   _____

NOTES



6. Write short notes on:

(a) Soil Health Card Scheme

_____

_____

_____

(b) Nutrients required by solanaceous crops

_____

_____

_____

Match the Columns

Soil type	Characteristics
1. Black soil	(a) highly acidic and black
2. Red soil	(b) rich in potash, calcium
3. Lateritic soil	(c) sandy soil found in low rainfall areas
4. Alluvial soil	(d) stony and infertile
5. Desert soil	(e) low water holding capacity
6. Forest and hilly soil	(f) coastal regions
7. Peat and marshy land	(g) poor in nitrogen, phosphate and lime

Session 2: Transplanting of Seedlings

Transplanting

Transplanting is a process, wherein a seedling is uprooted from a nursery bed and transplanted to a permanent place, where it grows to produce yield. Solanaceous vegetable crops can endure transplanting shock and are able to form secondary roots. Hence, these can successfully be transplanted. Tomato, brinjal and chilli are ready for transplantation in 4–5 weeks after sowing.

Fig. 3.6: Seedlings of chilli in pro-trays

Fig. 3.7: Seedlings of tomato in pro-trays

Selection of seedlings for transplanting

In solanaceous vegetable crops, 4–5 weeks old seedlings with 10–15 cm height (4–5 leaves) are suitable for transplanting (Fig. 3.6 and 3.7). Do not select weak, lanky and overgrown seedlings. Watering of the nursery bed is required just before uprooting. During transplanting, a seedling must be:

- vigorous and sturdy
- having a healthy root system
- free from insects, pests and diseases
- hardened in the nursery

Ideal conditions for transplanting

Transplanting is done when the weather is cloudy, cool and moist. During sunny days, transplanting is preferred late in the afternoon to allow the seedlings to recover at the low temperature of the night.

Procedure for transplanting

Holes are made in the main field with the help of a *khurpi* or a shovel at a specified distance for a crop. One seedling is placed in each hole. Cover its roots with soil firmly. The seedlings of solanaceous crops are transplanted on a flat bed or on sides of ridges. When planted on a flat bed, ridges and furrow are made after the seedlings set firmly. Irrigation should be done immediately after transplanting. In the initial stages, seedlings are transplanted at the side of ridges, and later, earthling up is done to bring the plant in the centre of the ridges.

However, raised bed planting system is becoming popular. Beds of 15–20 cm height and 1.2 m width, irrespective of length, are prepared. These beds are either furrow irrigated or drip irrigated. Polythene mulching is another intervention to minimise weeds and save water.

Irrigation is preferably localised along plant rows, leaving areas between the rows dry for transplanting operation. This is possible with furrow and drip irrigation but not with sprinkle irrigation. Irrigate the field 2–3 days before transplanting, if the soil is sandy or sandy loam. In case of clayey soils, irrigate 5–6 days prior to transplanting. Light irrigation is necessary immediately after transplanting for better field stand of seedlings.

Time of transplanting

Solanaceous vegetable crops are warm season crops. In India, these can be grown throughout the year in areas where winters are less severe. *Kharif* season crops, like tomato, brinjal and chilli are sown in June–July and transplanted in the months of July–August. *Rabi* or winter season crops are sown in September–October and transplanted in November–December.

For summer crops, seeds are sown in January–February and transplanted in February–March.

Transplanting shock

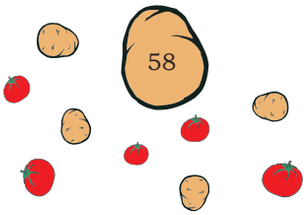
Transplanting shock means temporary retardation in growth or subsequent mortality of seedlings just after transplanting. This can be prevented by hardening of the seedlings by withholding water for 3–5 days before transplanting. Seedlings can recover easily if watered frequently for about a week after transplanting.

Precautions

(a) Water the seedlings before uprooting them in order to reduce root injury.
(b) Tie the seedlings in suitable bundles for taking them to the field.
(c) Do not place the seedlings under direct sunlight after uprooting them.
(d) Protect the seedlings from farm animals.
(e) Preferably choose evening hours for transplanting.
(f) Treat the roots of seedlings with fungicides or insecticides to prevent them from diseases, insects and pests.
(g) Ensure that the field is kept moist for better growth of the seedlings.

Staking (in tomato and chilli)

Staking is supporting a plant's stem or branches by tying them to wooden or metal stakes (planks). Staking prevents dislodging of the plant due to wind. It is observed that when solanaceous plants bear heavy fruiting, their branches may get broken or bend downwards. The breakage of branches reduces the yield, while their bending brings the fruits in contact with the soil and impairs their quality. Staking is, generally, done to support the plant to keep it in an upright position and the fruits in a hanging position above the ground. Individual plants are staked on wooden or metal planks. Indeterminate type of varieties are staked by tying them to strings or wires running across rows. Lines of strings are strung between the stakes in order to provide support to the plant. A stake of 5–6 feet high is required for the



staking of an indeterminate variety, while in case of a determinate variety, 3–4 feet high stake is needed.

Method and time of potato planting

Fig. 3.8: Potato crop in a field

Potato crop is raised by planting tubers or pieces of a tuber directly in the main field at required spacing (Fig. 3.8). After the preparation of the land, the potato seeds are planted in ridge and furrow system. In the manual method of planting, potato seed tubers are planted on the north side of each ridge, whereas, furrows are made with the help of a tractor drawn 2–4 row planter-cum-fertiliser drills. Care is taken that seed tubers do not come in contact with fertilisers.

Potato is taken as a winter season crop in plains. The best temperature required for growing the crop is 30–32 °C and the minimum is 10–20 °C. In plains, September–October is the best time for planting potatoes. In hills, a temperature range of 20–22 °C (maximum) and 12–15 °C (minimum) is suitable for potato cultivation.

Spacing

Appropriate spacing to get the optimum plant population is important for getting the maximum yield and better quality produce, without unduly increasing the cost of production. Closer spacing gives higher yield but the tuber size is reduced. Besides, it increases the incidence of pests and diseases. The spacing for the transplanting of solanaceous crops is given in Table 3.5.

Table 3.5: Spacing for solanaceous crops

Crops	Spacing in cm (row-to-row x plant-to-plant)
Tomato	60 x 45 (determinate varieties/hybrids) 90 x 60 (indeterminate varieties/hybrids)
Brinjal	60 x 45 (long fruits) 90 x 90 (round fruits)
Chilli	45 x 45
Potato	60 x 20

Cropping system

Intercropping

This is a cropping system, wherein two or more crops are grown simultaneously in alternate rows or otherwise on the same land, showing significant amount of intercrop competition.

Selection of intercrop

- Short duration and shallow-rooted crop is selected as an intercrop with a deep-rooted crop.
- The prevailing climatic conditions should be favourable for the selected crops.
- The selected crops, preferably, should not have common insects, pests or diseases.
- The growing habit of one crop does not affect the growth of the other.
- The selected intercrop flourishes well in the space between two rows of the crop.

Suitable intercrop(s) with solanaceous vegetables

(a) Brinjal + Radish
(b) Tomato + Radish + Lettuce
(c) Tomato + Spinach
(d) Brinjal + Cauliflower

Advantages

(a) Intercropping increases production from a land without reducing the yield of the main crop.
(b) It provides better utilisation of land, labour and other resources.
(c) It provides additional income to farmers.
(d) Intercrops maintain a soil's fertility as nutrient uptake is obtained from different layers of the soil.
(e) Intercropping reduces soil erosion and helps in weed control.
(f) Intercrops provide shade and support to other crops planted on the same land.

Disadvantages

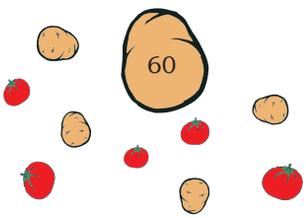
(a) Intercropping may require more agricultural inputs.
(b) Machines are needed for intercultural operations.
(c) There may be allelopathic effect (direct or indirect harmful effect of one plant on another).
(d) Disease, and insects or pests may harbour more on the preferred host crop as compared to intercrops.

Crop rotation

It is a system of growing crops in recurrent succession on the same land either in a year or over a longer period of time.

Selection of crop for rotation

Companion crops are chosen with due care so that the soil's health is not impaired. Here, the cycle of cropping



sequence takes more than one year to complete. Crops with different types are included in rotation, so the chances of harbouring of insects and pests can be checked. A shallow-rooted crop is rotated with a deep-rooted crop in order maintain the soil's productivity.

Suitable crop rotation with solanaceous vegetables

- Early cauliflower (July to September) – brinjal (October to March) – *amaranth* (March to June)
- Green manure crop (June to July) – early tomato (August to December) – onion (December to May)
- Brinjal (May to October) – pumpkin (October to February) – okra (February to May)
- Okra (June to October) – cauliflower (November to February) – tomato (February to June)
- Okra (June to October) – potato (October to February) – tomato (February to June)
- Tomato (June to November) – onion (December to May)
- Potato (October first week to December) – wheat – maize
- Potato (October first week to December) – wheat – paddy
- Potato (November to January) – okra (February to May) – soybean

Advantages

(a) Crop rotation improves and maintains soil fertility.
(b) It helps in preventing pests, weeds and soil-borne diseases.
(c) It also checks soil erosion.
(d) Crop rotation conserves soil moisture in a field.

What have you learned?

Now, I am able to:

- understand the transplanting process.
- assess the spacing of crops in transplanting.
- understand intercropping and crop rotation.

Practical Exercises

Activity 1: Demonstrate the transplanting of seedlings.
Material required: Khurpi, shovel and seedlings
Procedure

- Prepare a suitable layout (flat bed or ridges and furrows) for planting.

- Mark the location for planting seedings at suitable spacing.
- Make holes at the point of planting with the help of a *khurpi* or shovel.
- Place one uprooted seedling in each hole.
- Cover it with soil and press the soil around the seedling firmly.
- Water it immediately.

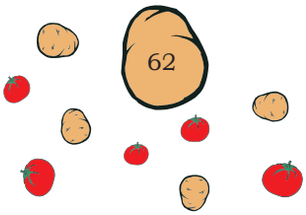
Check Your Progress

Fill in the Blanks

1. In plains, planting time of potato is _____.
2. The appropriate height of seedlings should be _____ at the time of transplanting.
3. The _____ facilitates to keep the fruits in hanging position above the ground.
4. _____ is a method of uprooting the selected seedlings from a nursery bed and planting them in the main field at suitable spacing.
5. Transplanting shock can be prevented by _____ of the seedlings.
6. Potato crop is raised by planting _____ directly in the main field.
7. The best temperature for planting potato is _____.
8. In intercropping, a _____ crop is selected with a deep-rooted crop.
9. _____ maintains and improves soil fertility.

Multiple Choice Questions

1. At the time of transplanting, a seedling must be _____.
   (a) vigorous and sturdy
   (b) having good root system
   (c) hardened in the nursery
   (d) all of the above
2. Transplanting is done when the weather is _____.
   (a) cloudy (b) cool
   (c) both a and b (d) hot
3. Solanaceous vegetable crops are also known as _____.
   (a) warm season crop
   (b) cool season crop
   (c) temperate crop
   (d) none of the above
4. The temporary growth retardation or subsequent mortality of seedlings after transplanting is called _____.
   (a) damping off
   (b) wilt
   (c) transplanting shock
   (d) none of the above



5. _____ means supporting the plant stem or branches by tying them to wooden or metal stakes (planks).
   (a) Rouging (b) Staking
   (c) Pruning (d) Intercropping
6. Potato crop is taken as _____ crop in plains.
   (a) summer season (b) rainy season
   (c) winter season (d) all the year round
7. Which of these system is followed when two or more crops are grown simultaneously in alternate rows?
   (a) mix cropping (b) intercropping
   (c) relay cropping (d) crop rotation
8. The system of growing crops in recurrent succession on the same piece of land either in a year or over a longer period of time is known as _____.
   (a) mix cropping (b) intercropping
   (c) relay cropping (d) crop rotation

Descriptive Questions

1. What is transplanting shock? How can it be minimised?
   _____
   _____
   _____
2. What is staking? Enumerate its advantages.
   _____
   _____
   _____
3. Write down the criteria for the selection of seedlings for transplanting.
   _____
   _____
   _____
4. Describe the method of potato planting.
   _____
   _____
   _____
5. Give the recommended spacing required for various solanaceous crops.
   _____
   _____
   _____

Match the Columns

Vegetables	Spacing
1. Tomato indeterminate type	(a) 60 × 20 cm
2. Long fruit bearing brinjal	(b) 45 × 45 cm
3. Chilli	(c) 60 × 45 cm
4. Potato	(d) 90 × 60 cm

Notes